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ABSTRACT

This booklet is intended to help mainstreamed mentally retarded, emotionally disturbed, or learning disabled high school students acquire a basic understanding of the responsibilities and working conditions of carpenters and to practice basic math skills necessary in the occupation. The first section provides a brief introduction to the occupation by focusing upon those job tasks of a carpenter with which the student is likely to be familiar. The next two sections deal with the work environment of the typical carpenter and the training, education, and experience needed for the occupation. Exercises addressing basic math skills used by carpenters are provided. Various suggestions are listed for students interested in further exploring the occupation of carpenter. A glossary and answer sheet conclude the booklet. (YLB)

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MATH on the job

Carpenter

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MATH ON THE JOB:

CARPENTER

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MATH on the job

Carpenter

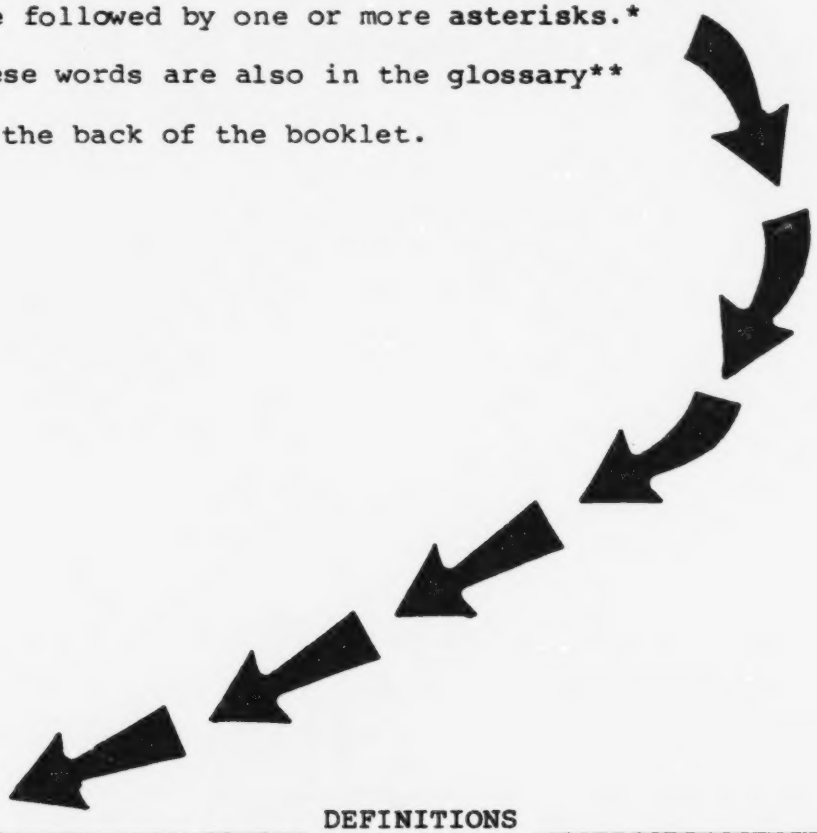
In this booklet, you can--

- find out what a carpenter does
- see how a carpenter uses math
- get a chance to use math as a carpenter
- find out the type of things a carpenter needs to know
- find out what courses, training, and education you need to become a carpenter

SPECIAL WORDS USED IN THIS BOOKLET

Workers in many jobs use special words or special meanings for words. Learning these words helps you to learn about a job.

You will find some of these special words in this booklet. When these words, and some hard words, are used for the first time, they are followed by one or more **asterisks.*** These words are also in the **glossary**** at the back of the booklet.



DEFINITIONS

*An asterisk (*) is a symbol that tells you to look at the bottom of the page for the meaning, or definition, of the word.

**A glossary is a list of words with their meanings.

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HAVE YOU EVER...

- fastened two pieces of wood together using a hammer and nails?
- used a hand or power-operated drill or saw?
- watched someone install a new door?
- looked at a set of house **blueprints***?

If you have, then you have some idea about the work of a carpenter. In this booklet, you will learn about the work of a carpenter and how math is important to do the job.

DEFINITION

*Blueprints are pictures that show how something is to be built or put together.

WHAT DOES A CARPENTER DO?

A carpenter uses hand tools and power tools to build and repair buildings and fixtures made from wood materials. A carpenter also--

- studies blueprints
- determines the type of material needed for the job
- selects the lumber and other materials
- marks cutting and fastening lines on the materials
- cuts the materials to the desired measurement
- fastens the materials together
- makes sure the finished product is level

As a carpenter, you may--

- build the main frame of a house or other building
- construct walls and roofs
- install doors, windows, and flooring
- make and install cabinets and other pieces of furniture
- build **scaffolding***, wooden bridges, stairways, and other platforms
- apply paneling to walls and ceilings

DEFINITION

*Scaffolding are temporary or movable platforms for workers to stand or sit on when they are working at a height above the floor or ground.

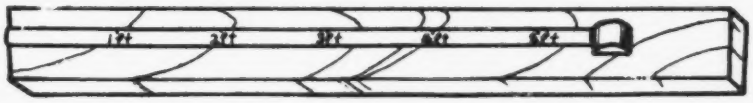
A carpenter uses math on the job every day. As a carpenter, you--

- add, subtract, multiply, and divide
- work with whole numbers, fractions, and decimals
- recognize and identify shapes such as squares, rectangles, and triangles
- take measurements with folding rules and steel tape measures
- determine the areas of different shapes
- convert scale measurements to actual size
- determine the amount of material needed to do a job
- carefully guess the costs of doing a job
- carefully guess the amount of time it takes to do a job

A carpenter uses math to measure materials.

EXAMPLE

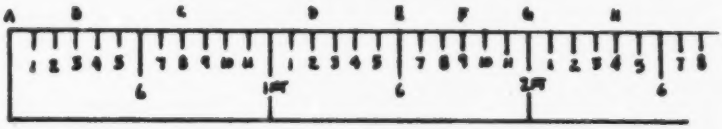
A carpenter must use measuring tools to cut materials to the correct size. Sometimes the carpenter will have to convert from one unit of measurement to another. A steel tape measure is marked in feet and inches. If the board should be 4-1/2 feet long, the carpenter must cut it at the spot measured 4 feet and how many inches from one end?



You're right if you said 6 inches.

NOW YOU TRY IT

Practice Exercise A



Using the tape measure pictured above, complete the following table.

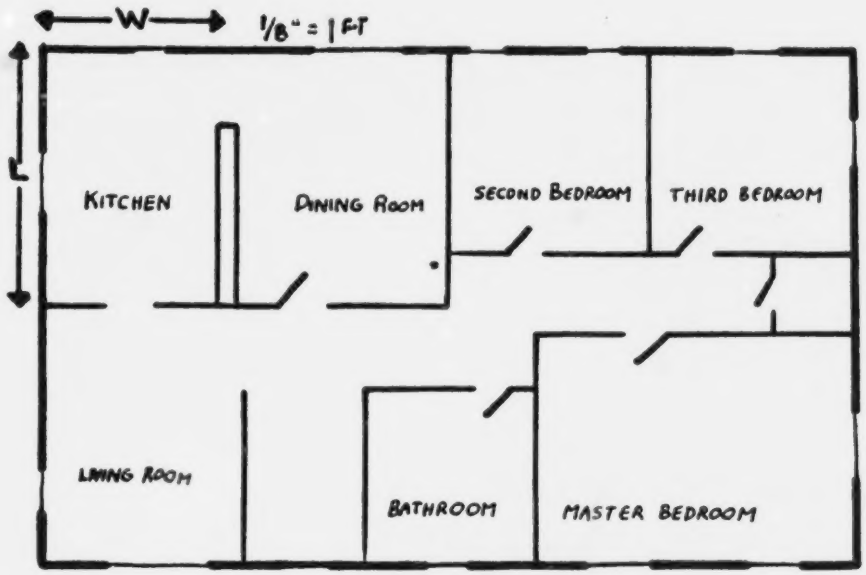
	From Point	To Point	Length in Feet	Length in Feet and Inches
1.	A	C	?	8"
2.	A	F	?	1' 9"
3.	A	D	1-1/6'	?
4.	A	H	?	?
5.	A	B	?	3"
6.	C	?	?	8"
7.	D	F	?	?
8.	E	B	?	?
9.	G	?	?	10"
10.	E	?	1/3'	?

A carpenter uses math to read and understand blueprints and drawings.

EXAMPLE

Many carpenters work on new houses being built or older houses being remodeled. Blueprints tell the size and shape of rooms. By using blueprints, a carpenter may not need to take as many measurements.

The scale on a blueprint tells how to convert blueprint measurements to actual sizes. The blueprint below has the scale 1/8" = 1'. If the dining room measures 1-1/2" on the blueprint, what is its actual length?

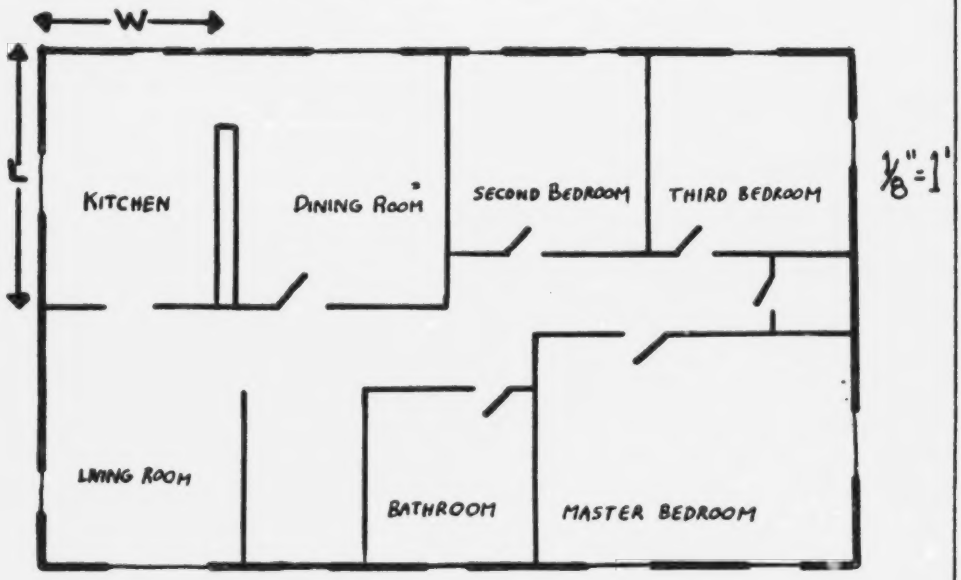


You're right if you said 12 feet.

NOW YOU TRY IT

Practice Exercise B

Use the blueprint below to answer questions 11-20.
Convert each answer to the actual size.



11. What is the actual length of the kitchen?

12. How wide is the master bedroom?

13. How long is the living room?

14. How wide is the living room?

15. How long is the second bedroom?

16. How wide is the dining room? How long is it?

17. How long is the bathroom? How wide is it?

18. How long is the third bedroom? How wide is it?

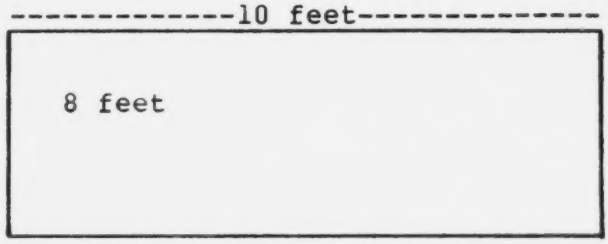
19. How long is the entire house?

20. How wide is the entire house?

A carpenter uses math to figure out areas.

EXAMPLE

A carpenter must be able to calculate areas to know how much material is needed to do a job. The wall shown below is 10 feet long and 8 feet high. How many square feet of paneling would be required to panel the wall?



You're right if you said 80 square feet.

NOW YOU TRY IT

Practice Exercise C

21. A wall measures 13 feet long and 7 feet high. How many square feet of paneling are needed to cover the wall?

22. You are to build a room partition 6-1/2 feet long and 4 feet high. How many square feet is the partition?

23. Two walls are to be built. One wall will be 11-1/2 feet long. The other wall will be 6-1/4 feet long, and both walls will be 7 feet high. How many square feet of paneling are needed?

24. A 2-1/2 by 9-foot countertop is to be covered with ceramic tile. If each tile is 1 square foot, how many tiles are needed?

25. The floor of a room measures 8'6" by 11'. How many square feet of wood flooring are needed to cover the floor?

A carpenter uses math to estimate job costs.

EXAMPLE

Some carpenters must provide estimates to their customers of how much a carpentry job will cost. To make sure a profit is made, the carpenter needs to know exactly what the cost of the materials will be. What is the total cost of the materials for the following job?

Materials to Build Cabinet	x	Cost per Item	=	Cost
Two 4'x6' oak boards		$12.99		$25.98
24 wood screws		.02		.48
4 brass hinges		.79		3.16
1 tube of glue		1.89		1.89
4 metal casters		2.15		8.60
1 pint of varnish		3.98		3.98
				?

You're right if you said $44.09.

NOW YOU TRY IT

Practice Exercise D

26. A customer wants a cabinet like the one in the example but without the 4 metal casters. What would be the cost of the materials?

27. A small bookcase requires four 1"x12" pine boards ($8.99 each), 40 wood screws (2¢ each), 1 can of wood stain ($6.99), and a package of sandpaper ($1.69) to build. What is the total cost of materials for the bookcase?

28. A carpenter spends $46.83 on materials for a video center. Then the customer requests the addition of plastic doors. The carpenter buys two doors ($16.50 each) and four brass hinges (79¢ each). What is the total cost of materials for the video center?

29. The materials needed to build a storage chest cost $18.87. If four customers want one chest each, what is the total cost of the materials?

30. The total cost of materials for 7 identical kitchen cabinets is $539.49. What is the cost of materials for one cabinet?

WHERE DOES A CARPENTER WORK?

There are two main types of carpentry work: rough carpentry and finish carpentry. An all-around carpenter is able to do both types of work.

A rough carpenter--

- makes frames for buildings
- puts on the outside walls of buildings
- installs partitions
- installs studding* and floor joists**
- makes concrete forms
- erects scaffolds
- builds temporary frame shelters

A finish carpenter--

- installs finished flooring
- builds stairways
- puts on siding
- puts up trim
- installs doors and windows
- installs the inside walls of buildings
- makes and installs cabinets

DEFINITIONS

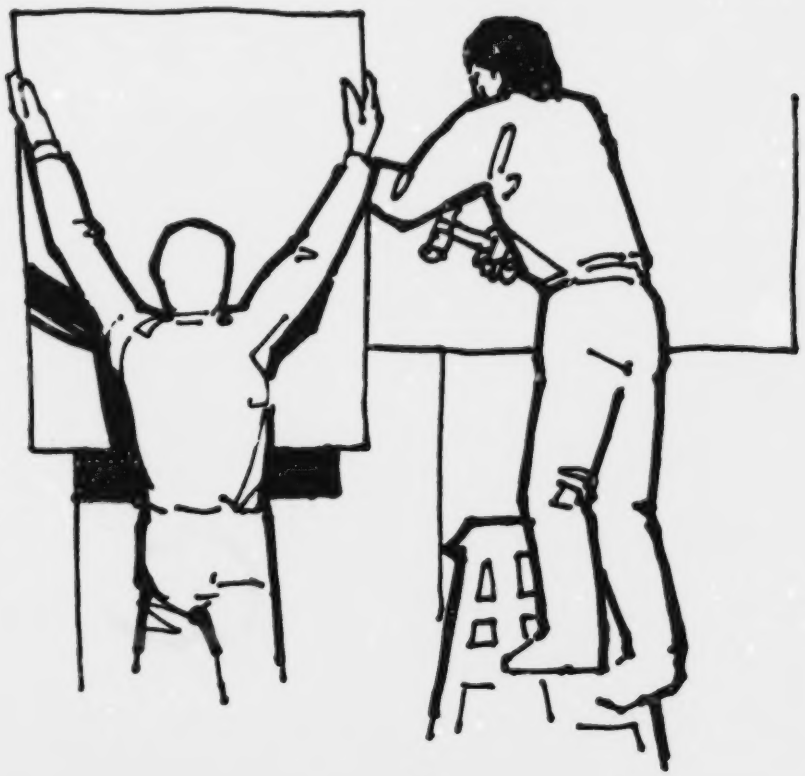
*Studding are thin wooden strips in the wall of a building. The inside wall of the building and the paneling are fastened to the studs.

**Floor joists are small timber or metal beams. They are laid out from wall to wall to support the floor.

A carpenter may work on construction sites, building such things as--

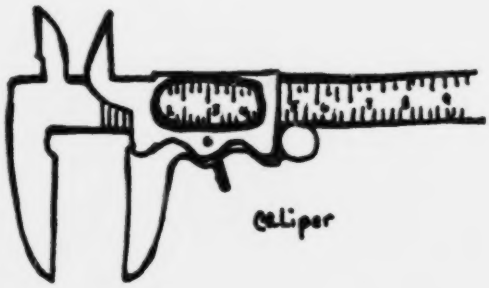
- houses
- office buildings
- factories
- warehouses
- shopping centers
- highways
- boats
- bridges

Some carpenters specialize in doing maintenance work and installing glass in windows and doors. They also replace damaged ceiling and floor tiles and repair counters, cabinets, floors, and doors. They can work for a factory, apartment complex, or government agency.



A carpenter works with special tools and types of equipment. Carpenters use such special tools for measuring as--

- steel tapes
- folding rules
- framing squares*
- calipers**



A carpenter uses such hand-operated tools as--

- crosscut saws
- screwdrivers
- chisels
- planes***
- hammers

DEFINITIONS

*Framing squares are instruments that have two straight edges and a right angle. They are used to lay out and test right angles to make sure the angle is correct.

**Calipers are instruments with two legs that can be adjusted. They are used to measure thickness, diameter, and distance between two surfaces.

***Planes are tools used for smoothing or shaping a wood surface.

A carpenter also uses gasoline or electric-powered tools, such as--

- portable saws
- power drills
- sanders

As a carpenter, you will learn to select and use tools that will help you do your job well.

As a carpenter, you will work with many people. You will have a supervisor who will assign work to you. You will work with other carpenters as a team to make sure the work is done correctly and on time. You may have a carpenter's helper who works with you, carries your tools, and helps you measure and lay out the working lines.

IF YOU ARE INTERESTED IN

THE WORK OF A CARPENTER

AND WOULD LIKE TO KNOW MORE,

READ ON

WHAT TRAINING, EDUCATION, AND EXPERIENCE DO YOU NEED TO BECOME A CARPENTER?

What do you think? Would you like to be a carpenter? If you would, there are some things you should know.

To get a job as a carpenter, you need to know how to--

- read blueprints and sketches
- do layout work
- do your work so that it meets **building codes***
- work with many building materials such as wood, plywood, wallboard, fiberboard, and insulation
- use the correct procedures to fasten materials with nails, screws, bolts, or glue
- use hand tools and power tools
- work well with others

The best way to become a carpenter is to complete a four-year apprenticeship program. To become an apprentice, you should be a high school graduate and have some understanding of carpentry. While in high school, you should take courses in mathematics, drafting, and wood shop.

DEFINITION

*Building codes are rules and guidelines for remodeling and constructing homes and buildings.

After you are accepted in an apprenticeship program, you will be trained on the job. You also will have classroom training in the care and use of tools, different types of building materials, and building code requirements.

You can learn more about the work of a carpenter by getting a summer or part-time job on a construction site. Some vocational schools offer classes in the basics of carpentry and the Armed Forces also offer some training.

DO YOU WANT TO DO MORE CARPENTER'S MATH?

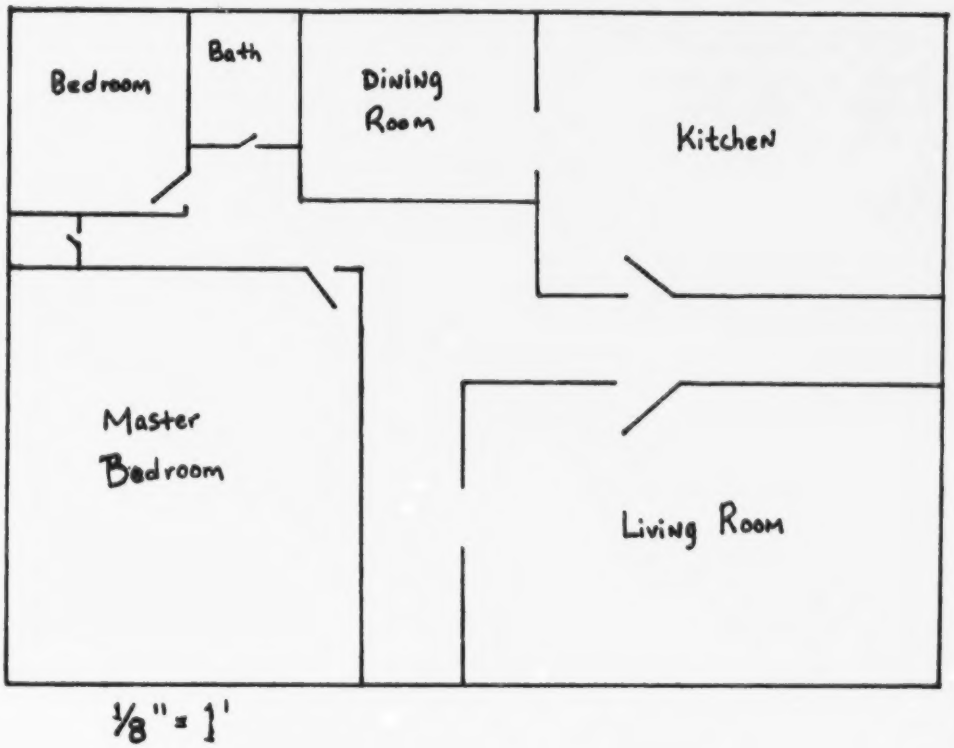
Practice Exercise E

The first column below shows the lengths of pieces of wood needed. For each problem, add the lengths to see if all the pieces can be cut from one 8-foot piece of wood. Figure out how much more wood is needed or how much wood is left over.

	Lengths of Pieces Needed	Is 8-foot Piece Enough? (Yes/No)	Extra Needed or Amount Left
31.	12-1/2", 8-1/4", 3'9", 29"	?	?
32.	4-1/2', 2', 3-1/3'	?	?
33.	14", 2'8", 5-1/6'	?	?
34.	3-1/2', 3'9", 28"	?	?
35.	6'2", 19", 1-1/4'	?	?
36.	2-1/2', 2"8", 1'9", 26"	?	?

Practice Exercise F

Use the following bluepint to answer questions 37-41.
Convert each answer to actual size.



	Room	Length	Width
37.	Living Room	?	?
38.	Bath	?	?
39.	Dining Room	?	?
40.	Master Bedroom	?	?
41.	Kitchen	?	?

Practice Exercise G

42. An 8' x 12' wall needs to be built. It has a 1' x 2' window and a 3' x 7' door in it. How much wallboard is needed to build the wall?

43. A room has walls 8 feet high. Two walls are 9-1/2 feet long. The other two are 14 feet long. How much paneling is needed to panel all four walls?

44. A backyard shed needs to be covered with plywood. It has a flat roof which measures 4'6" by 6'6". Two walls are 4'6" by 7'. The other two walls are 6'6" by 7'. How much plywood is needed?

45. A square room with four walls is to be built. Each wall measures 12'3" long and 7'9" high. There are two windows (2'6" x 3'4" and 4'8" x 3'4") and one door (2'9" x 6'9"). How much wallboard is needed to build all four walls?

46. A carpenter is covering an old cabinet with new wood veneer. The front is 6' x 4', the two sides are each 2-1/2' x 4' and the top is 2-1/2' x 6'. How many square feet of veneer are required?

Practice Exercise H

47. A carpenter decides to charge the customer 25% of the total materials cost for the labor. If the materials cost $65.75, what is the labor charge?

48. The cost of materials for a carpentry job is $238.30. If 22% of this is added on as a labor charge, what is the total job cost to the customer?

49. The cost of materials for another job is $174.89. The carpenter adds 25% of that number as a labor charge. Then a sales tax of 10% is added onto the previous subtotal. What is the grand total owed by the customer?

50. A carpenter is building kitchen cabinets. There are $4.39 worth of wood screws on hand, but the screws are enough for only 1-1/2 cabinets. What is the cost of enough screws for 4 cabinets? (Hint: use ratios to solve.)

DO YOU WANT TO EXPLORE SOME MORE?

1. Ask your high school counselor if you can visit the wood shop or carpentry class. Ask the teacher of the class about the skills that are taught. Ask about the tools that are used. Find out what things are built in the class.

2. Telephone or write to the local carpenters' union. Find out what the requirements are to become an apprentice. Find out what classes you should take. Find out how many apprentices the union accepts each year.

3. Talk to one (or more) carpenter(s) in your community about the work. Find out what things the carpenter likes about the job. Find out what things the carpenter doesn't like about the job.

4. Try to obtain a set of house plans from a lumber yard, architect, builder, or carpenter. Look at the house plans. Notice the scale the plans are drawn in. See if you can find where the windows and doors are placed.

5. Are you interested in other jobs in the construction industry?

   - Plumbers install and repair pipes that are used to transport water and gas.
   - Electricians install and repair wiring and electrical machinery.
   - Roofers install and repair roofs.
   - Bricklayers build walls and other structures with brick and similar materials.
   - Cement masons place and finish concrete in such forms as patios, floors, and highways.
   - Painters apply coats of paint, varnish, and stain to the ceilings and inside and outside walls of buildings.

   You must have good math skills to do these jobs well. Most of these workers use addition, subtraction, multiplication, and division in their work every day.

GLOSSARY

Asterisk (*): a mark that tells you to look at the bottom of the page for the meaning, or definition, of the word.

Blueprints: pictures that show how something is to be built or put together.

Building codes: rules and guidelines for remodeling and constructing homes and buildings.

Calipers: instruments with two legs that can be adjusted. They are used to measure thickness, diameter, or distance between two surfaces.

Floor joists: small timber or metal beams. They are laid out from wall to wall to support the floor.

Framing squares: instruments that have two straight edges and a right angle. They are used to lay out and test right angles to make sure the angle is correct.

Glossary: a list of words with their meanings.

Planes: tools used for smoothing or shaping a wood surface.

Scaffolding: temporary or movable platforms for workers to stand or sit on when working at a height above the floor or ground.

Studding: thin wooden strips in the wall of a building. The inside wall of the building and paneling are fastened to the studs.

ANSWER SHEET

Practice Exercise A

1. 2/3'
2. 1-3/4'
3. 1'2"
4. 2-1/3', 2'4"
5. 1/4'
6. A, 2/3'
7. 7/12', 7"
8. 1-1/4', 1'3"
9. D, 1-5/6"
10. D, 4"

Practice Exercise B

11. 12'
12. 15'
13. 12'
14. 10'
15. 9'
16. 10';12'
17. 8';8'
18. 9';9'
19. 24'
20. 38'

Practice Exercise C

21. 91 sq. ft.
22. 26 sq. ft.
23. 124.25 sq. ft.
24. 22.5 tiles
25. 93.5 sq. ft.

Practice Exercise D

26. $35.49
27. $45.44
28. $82.99
29. $75.48
30. $77.07

Practice Exercise E

31. Yes (94-3/4"), 1-1/4" left
32. No (118"), 22" needed
33. No (108"), 12" needed
34. No (115"), 19" needed
35. Yes (48"), 48" left
36. No (109"), 13" needed

Practice Exercise F

37. 14';22'
38. 6-1/2';5-1/2'
39. 9';11'
40 19';16-1/2'
41. 13';19'

Practice Exercise G

42. 73 sq. ft.
43. 376 sq. ft.
44. 106.25 sq. ft.
45. 337.35 sq. ft.
46. 75 sq. ft.

Practice Exercise H

47. $ 16.44
48. $290.73
49. $236.10
50. $ 11.70